No. X.

KEYSTONE

Switchboard and Portable Voltmeters, Ammeters, Wattmeters, Ground Detectors, and other Measuring Instruments.

Pleasing in Appearance

Sensitive and Accurate

Constant and Durable

PROTECTED BY UNITED STATES PATENTS.

Manufactured and Sold by

Keystone Electrical Instrument Co.

Ninth Street and Montgomery Avenue,

PHILADELPHIA.

KEYSTONE INSTRUMENTS.

SINCE the issuance of our last regular price-list we have so greatly improved and extended our line of Instruments, having added a complete line of Portables, that we feel the necessity of placing all our separate price-lists and announcements under one cover. Listed herein will be found a complete list of Switchboard and Portable Indicating Instruments, meeting, we believe, every possible requirement of the profession.

It has been our aim to eliminate from our product every possible objection which heretofore has been raised against Instruments of our own or other manufacture, and we believe our customers will bear us out in the statement that we have met with complete success in this effort. We feel we can come before the public with a line of Instruments which require no apology and which will meet fully, not only our own representations, but also the most stringent requirements of modern engineering practice. Under each particular class of Instrument will be found a brief description, which, in connection with the illustrations, should enable users to select the particular type best suited to their needs.

We desire to call particular attention to the fact that we hold Letters Patent issued by the United States covering fully the only practical system whereby a switchboard Instrument may be constructed to read with equal accuracy on both direct and alternating current circuits. The employment of this principle permits the use of an Instrument on any and all circuits in a station, whether direct or alternating, in general giving the advantage of a universal and interchangeable Instrument.

As applying to our entire line we would submit the following general description of our methods and Instruments:

Our standards are absolute, and kept in constant check, so that the liability of a fundamental error in calibration is eliminated, while our methods and facilities for mechanical construction are so complete that there is no possibility of mechanical defects.

Contrary to usual custom, we do not consider Ammeters good enough for shipment when their indications are approximately correct, but maintain as high a degree of accuracy in them as in our Voltmeters.

We meet the customary requirements of high grade Instruments fully, such as dust proof cases, jeweled bearings, absence of effect from external magnetism, no change of indication by reason of temperature variations, no heating in the Instrument itself, and all Instruments dead-beat.

Insomuch as a series Ammeter is far more accurate and reliable for direct current work, and is the only form adapted for use on the alternating current, we adhere to this form. All connections being made at the back of switchboard.

In all our Switchboard Instruments the scales are suppressed at low range, so that the working part of the scale may be spread over a greater scale length, thereby facilitating readings as is now dictated by the best practice. Our Direct Current Portable Volt and Ammeters, and also our Arc Light Voltmeter and Ground Detector have equally divided scales from zero to maximum reading.

All Switchboard Voltmeters and Ammeters are provided with an adjustable index to mark the running point or maximum load.

Estimates will be cheerfully furnished for any special Instrument desired.

Portable Voltmeters for Direct and Alternating Current Circuits.

These Voltmeters are adapted for use on either alternating or direct current circuits and are absolutely correct.

Nothing is incorporated which is subject to change or deterioration, and having been calibrated from absolute standards of voltage, may be relied upon to maintain their accuracy.

There is no magnetic lag nor any error due to self-induction, therefore, they are independent of frequency variations on the alternating current.

Mounted in highly polished mahogany cases with key lock and leather carrying handle. A pair of flexible leads with tips is supplied with each Instrument for which a special compartment is provided.

These Voltmeters are dead-beat without the use of a mechanical brake.

When used on the direct current, owing to the extreme sensibility of the Voltmeter readings should be taken with the current flowing through the Instrument in one direction, then direction of current reversed and mean reading used. This reversal can be easily accomplished by turning reversing switch from "ON" at the right to "ON" at the left. When switch is turned to "OFF" no current flows through the Instrument.

Portable Voltmeters for Direct and Alternating Current Circuits.

SINGLE SCALE INSTRUMENTS.

NO.										PRICE
5.	Scale	1	to	12	volts in	$\frac{1}{10}$	volt	divisions,		$58 00
6.	"	3	"	20	"	$\frac{1}{5}$	"	"		59 00
7.	"	5	"	40	"	$\frac{1}{2}$	"	"		60 00
8.	"	15	"	80	"	$\frac{1}{2}$	"	"		61 00
9.	"	20	"	120	"	1	"	"		63 00
10.	"	30	"	150	"	1	"	"		65 00
11.	"	60	"	300	"	2	"	"		70 00
12.	"	100	"	700	"	5	"	"		75 00

DOUBLE SCALE INSTRUMENTS.

NO.									PRICE
15	Scale	5	to	40	volts in	$\frac{1}{2}$	volt	divisions,	$70 00
	"	2.5	"	20	"	$\frac{1}{4}$	"	"	
16.	"	15	"	80	"	$\frac{1}{2}$	"	"	71 00
	"	7.5	"	40	"	$\frac{1}{4}$	"	"	
17.	"	20	"	120	"	1	"	"	73 00
	"	10	"	60	"	$\frac{1}{2}$	"	"	
18.	"	30	"	150	"	1	"	"	75 00
	"	15	"	75	"	$\frac{1}{2}$	"	"	
19.	"	60	"	300	"	2	"	"	80 00
	"	30	"	150	"	1	"	"	
20.	"	100	"	700	"	5	"	"	85 00
	"	50	"	350	"	2.5	"	"	

Discount,.....

Prices on multipliers for any of the above ranges will be furnished on application.

Keystone Portable Ammeters for Alternating Current Circuits.

NO.									PRICE
310.	Scale	$\frac{4}{10}$	to	2	Amperes in	$\frac{1}{20}$	Amp.	divisions,	$40 00
311.	"	1	"	5	"	$\frac{1}{10}$	"	"	40 00
312.	"	2	"	10	"	$\frac{1}{10}$	"	"	40 00
313	"	3	"	15	"	$\frac{1}{5}$	"	"	40 00
314	"	5	"	25	"	$\frac{1}{2}$	"	"	40 00
315.	"	10	"	50	"	$\frac{1}{2}$	"	"	40 00
316.	"	20	"	100	"	1	"	"	45 00
317.	"	20	"	150	"	2	"	"	50 00
318.	"	30	"	200	"	2	"	"	55 00
319.	"	30	"	250	"	5	"	"	57 50
320.	"	50	"	300	"	5	"	"	60 00
321.	"	50	"	400	"	5	"	"	65 00
322.	"	50	"	500	"	10	"	"	70 00

Discount,.....

Portable Milli-Ammeter for Alternating Current Circuits.

The growing tendency on the part of Station Managers to test transformers has led us to put out an Alternating Current Milli-Ammeter for this purpose. This is the first Instrument of this character which has been offered to the public, and by its use it is possible to measure directly the current consumed in energizing the primary coil of a transformer when the secondary is on open-circuit, thereby determining the "idle losses" of a transformer system without complicated tests or calculations. We believe a trial will convince all of the usefulness of this Instrument.

We also list on the next page our line of Portable Wattmeters for use on the Direct or Alternating Current. These Instruments will be found useful for a large variety of tests, but particularly in testing the Watt consumption of incandescent or arc lamps.

Both the Milli-Ammeter and Wattmeter are mounted in polished mahogany cases with carrying handle, and are similar in construction and finish to our Portable Voltmeters for use on Direct and Alternating Current Circuits.

We can fully guarantee both of these lines to be accurate in calibration, well made and durable.

Keystone Portable Alternating Current Milli=Ammeter.

NO.								PRICE
55.	Scale	5 to 50	M. A.	in	½	M. A.	divisions,	$58 00
56.	"	10 to 100	"	"	1	"	"	60 00
57.	"	20 to 200	"	"	2	"	"	62 00
58.	"	30 to 300	"	"	2	"	"	64 00
59.	"	40 to 400	"	"	5	"	"	66 00
60.	"	50 to 500	"	"	5	"	"	68 00

Discount, ...

Keystone Portable Wattmeters for Direct and Alternating Current Circuits.

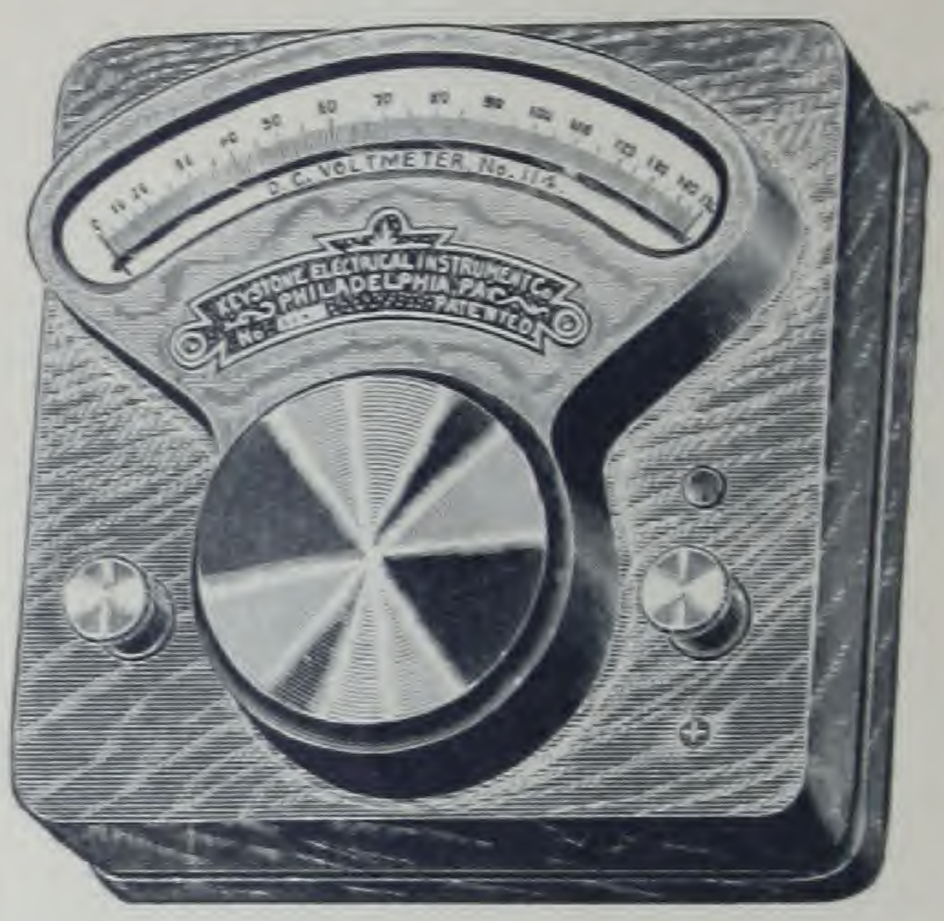
NO.	SCALE.						MAX. CURRENT.	MAX. VOLTAGE.	PRICE
25	0 to 300	Watts	in	2	Watt	divisions,	2 Amps.	150 Volts	$65 00
26	0 to 1,500	"	"	10	"	"	10 "	" "	70 00
27	0 to 3,750	"	"	25	"	"	25 "	" "	75 00
28	0 to 7,500	"	"	50	"	"	50 "	" "	80 00
29	0 to 15,000	"	"	100	"	"	100 "	" "	85 00
30	0 to 30,000	"	"	200	"	"	200 "	" "	90 00
35	0 to 600	"	"	5	"	"	2 "	300 "	70 00
36	0 to 3,000	"	"	20	"	"	10 "	" "	75 00
37	0 to 7,500	"	"	50	"	"	25 "	" "	80 00
38	0 to 15,000	"	"	100	"	"	50 "	" "	85 00
39	0 to 30,000	"	"	200	"	"	100 "	" "	90 00
40	0 to 60,000	"	"	500	"	"	200 "	" "	95 00
45	0 to 1,200	"	"	10	"	"	2 "	600 "	75 00
46	0 to 6,000	"	"	50	"	"	10 "	" "	80 00
47	0 to 15,000	"	"	100	"	"	25 "	" "	85 00
48	0 to 30,000	"	"	200	"	"	50 "	" "	90 00
49	0 to 60,000	"	"	500	"	"	100 "	" "	95 00
50	0 to 120,000	"	"	1,000	"	"	200 "	" "	100 00

Discount, ...

Prices on Multipliers for the Volt coils of any of the above on application.

Inspectors' style of Wattmeter, for testing incandescent lamps, furnished without extra charge. These Instruments have the current binding-posts omitted and a T-H lamp base with Edison adaptor substituted.

Portable Voltmeter and Ammeter for Direct Current Circuits.



The above cut illustrates our latest form of Direct Current Portable Voltmeter and Ammeter, which will be found well adapted to the needs of the Profession.

The mechanism, which is well and substantially constructed and adapted to withstand the hard service usually accorded a Portable Instrument, is enclosed in a neat metal case mounted on a polished mahogany base. These instruments are strictly high grade in every respect, and are designed as standards of Potential and Current. The scale is practically uniform throughout its range and is accurate at all points. All indications are dead-beat.

Each instrument is supplied with a polished cherry carrying case.

Keystone Portable Voltmeters and Ammeters for Direct Current Circuits.

VOLTMETERS, SINGLE SCALE.

NO.		PRICE
65.	Scale 0 to 10 Volts in $\frac{1}{10}$ Volt divisions,	$40 00
66.	" 0 to 25 " " $\frac{1}{5}$ " "	40 00
67.	" 0 to 120 " " 1 " "	43 00
68.	" 0 to 150 " " 1 " "	45 00
69.	" 0 to 300 " " 2 " "	50 00
70.	" 0 to 700 " " 5 " "	55 00

VOLTMETERS, DOUBLE SCALE.

NO.		PRICE
75.	Scale 0 to 120 Volts in 1 Volt divisions, " 0 to 60 " " $\frac{1}{2}$ " "	$53 00
76.	" 0 to 150 " " 1 " " " 0 to 75 " " $\frac{1}{2}$ " "	55 00
77.	" 0 to 300 " " 2 " " " 0 to 150 " " 1 " "	60 00
78.	" 0 to 700 " " 5 " " " 0 to 350 " " 2.5 " "	65 00

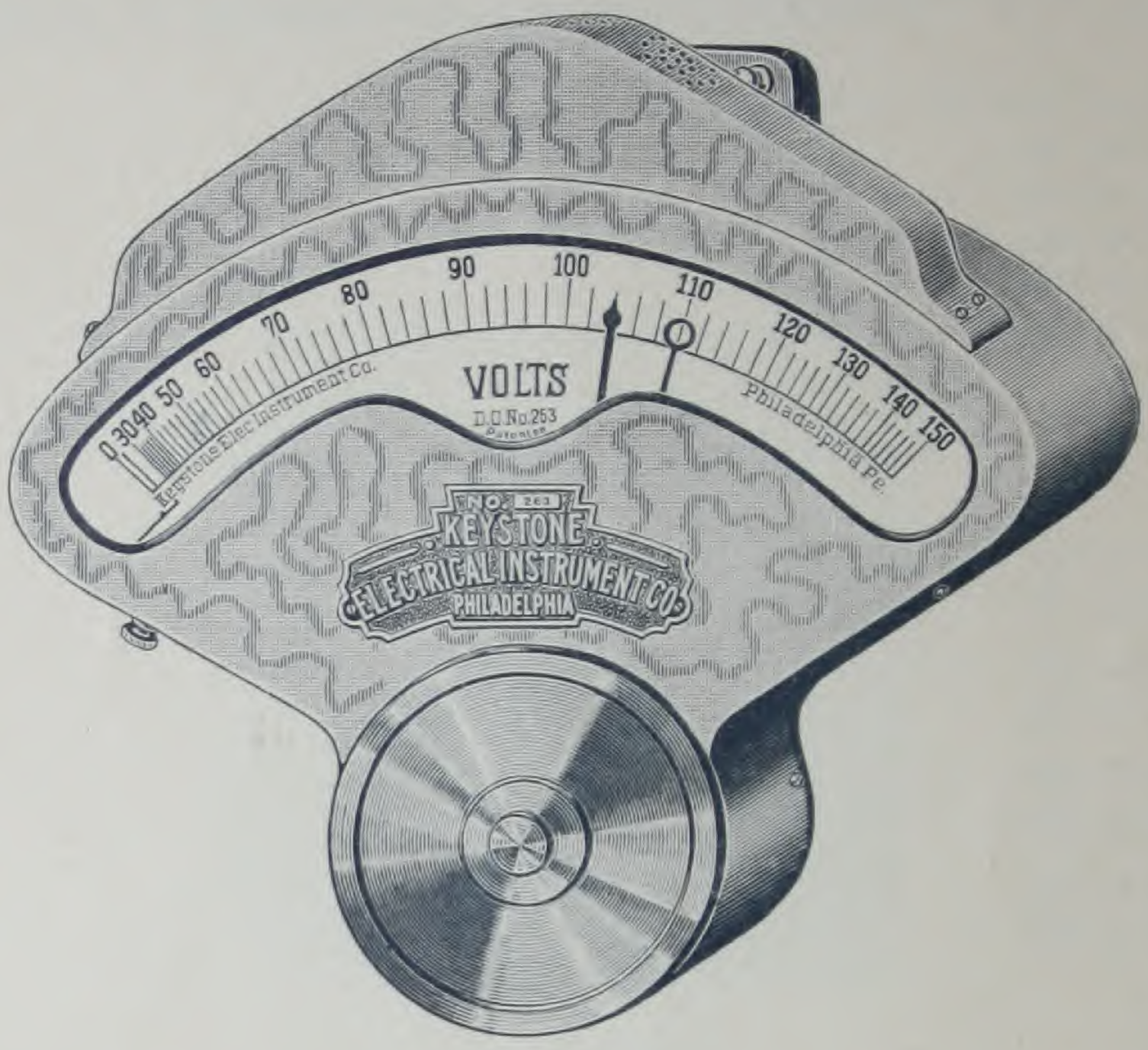
AMMETERS.

NO.		PRICE
80.	Scale 0 to 5 Amps. in $\frac{1}{20}$ Amp. divisions,	$40 00
81.	" 0 to 10 " " $\frac{1}{10}$ " "	40 00
82.	" 0 to 15 " " $\frac{1}{10}$ " "	40 00
83.	" 0 to 25 " " $\frac{1}{5}$ " "	40 00
84.	" 0 to 50 " " $\frac{1}{2}$ " "	40 00
85.	" 0 to 100 " " 1 " "	42 50
86.	" 0 to 150 " " 1 " "	45 00
87.	" 0 to 200 " " 2 " "	47 50
88.	" 0 to 250 " " 2 " "	50 00
89.	" 0 to 300 " " 2 " "	52 50
90.	" 0 to 400 " " 5 " "	57 50
91.	" 0 to 500 " " 5 " "	62 50

Discount, _____

Prices on multipliers for any of the above ranges of Voltmeters will be furnished on application.

TYPE "K,"
Illuminated Dial Switchboard Instruments.



Our Type "K" Illuminated Dial Instruments, listed on the following page, are designed for use on switchboards in which appearance is an important factor. We believe them to be more attractive in appearance than any line of Switchboard Instruments now available. As will be noted, the scale is large and very open around the normal working point; the dials are well illuminated by means of two standard lamps run two in series and set in such position under the illuminating hood that they light the scale brilliantly and without shadows; the cases are finished in brass, grained and lacquered. Each Instrument is provided with an index to show the running point in the case of the Voltmeter, or to mark the maximum load in the case of the Ammeter. Instruments are secured to the board by means of three studs passing through the board from the back of the Instrument. The Ammeters are constructed on the series principle, with terminals extending through the board for back connection.

These Instruments are calibrated for use on the direct current or the alternating current of any specified frequency, and if desired can be arranged for use on both circuits by the insertion of our patented inductive shunt, at an advance of 10% on list prices.

An extra charge of $3.00 will be made for a finish in full nickel or full copper.

TYPE "K," ILLUMINATED DIAL.

Calibrated for either Direct or Alternating Current.

VOLTMETERS.

NO.						WORKING RANGE		PRICE
110—0 to	10	Volts in	$\frac{1}{10}$	Volt	divisions,	1 to 10	Volts,	$70 00
111—0 to	25	"	$\frac{1}{2}$	"	"	5 to 25	"	71 00
112—0 to	40	"	$\frac{1}{2}$	"	"	5 to 40	"	72 00
113—0 to	80	"	1	"	"	10 to 80	"	73 00
114—0 to	130	"	2	"	"	20 to 130	"	74 00
115—0 to	150	"	2	"	"	20 to 150	"	75 00
116—0 to	300	"	5	"	"	50 to 300	"	80 00
117—0 to	600	"	10	"	"	100 to 600	"	85 00

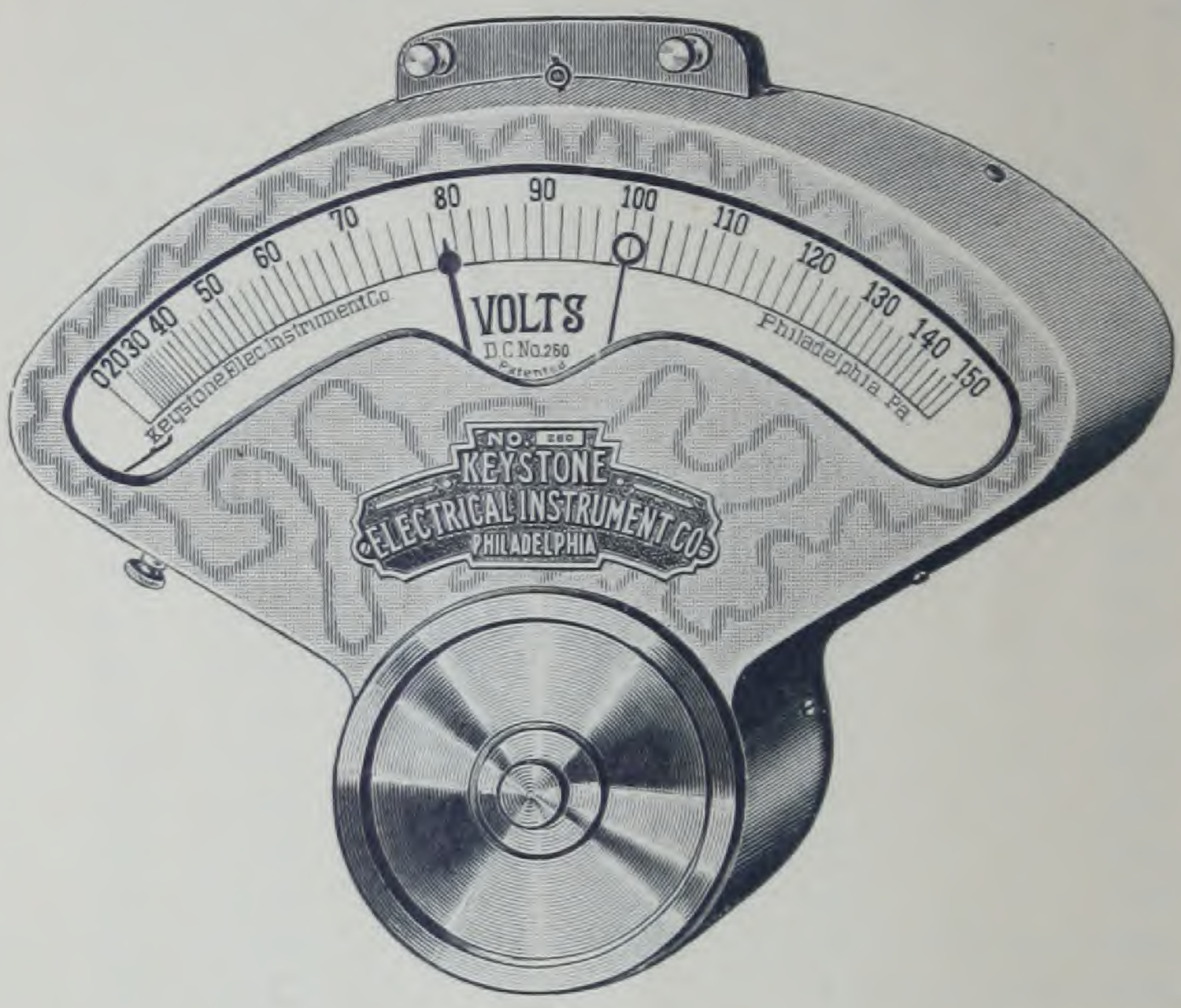
AMMETERS.

NO.						WORKING RANGE		PRICE
125—0 to	5	Amperes in	$\frac{1}{10}$	Amp.	divisions,	1 to	5 Amps.,	$62 00
126—0 to	10	"	$\frac{1}{10}$	"	"	2 to	10 "	62 00
127—0 to	15	"	$\frac{1}{5}$	"	"	3 to	15 "	62 00
128—0 to	25	"	$\frac{1}{2}$	"	"	5 to	25 "	62 00
129—0 to	50	"	$\frac{1}{2}$	"	"	10 to	50 "	62 50
130—0 to	75	"	1	"	"	10 to	75 "	65 00
131—0 to	100	"	1	"	"	20 to	100 "	66 25
132—0 to	125	"	2	"	"	20 to	125 "	67 50
133—0 to	150	"	2	"	"	20 to	150 "	68 75
134—0 to	175	"	2	"	"	30 to	175 "	70 00
135—0 to	200	"	2	"	"	30 to	200 "	71 00
136—0 to	250	"	5	"	"	30 to	250 "	73 00
137—0 to	300	"	5	"	"	50 to	300 "	75 00
138—0 to	400	"	5	"	"	50 to	400 "	80 00
139—0 to	500	"	10	"	"	50 to	500 "	85 00
140-0 to	600	"	10	"	"	50 to	600 "	90 00
141—0 to	800	"	10	"	"	100 to	800 "	95 00
142—0 to	1,000	"	10	"	"	200 to	1,000 "	100 00
143—0 to	1,500	"	20	"	"	300 to	1,500 "	105 00
144—0 to	2,000	"	20	"	"	300 to	2,000 "	110 00
145—0 to	2,500	"	25	"	"	300 to	2,500 "	115 00
146—0 to	3,000	"	50	"	"	500 to	3,000 "	120 00
147—0 to	3,500	"	50	"	"	500 to	3,500 "	125 00
148—0 to	4,000	"	100	"	"	500 to	4,000 "	130 00
149—0 to	4,500	"	100	"	"	500 to	4,500 "	135 00
150—0 to	5,000	"	100	"	"	1,000 to	5,000 "	140 00
151—0 to	6,000	"	100	"	"	1,000 to	6,000 "	145 00
152—0 to	7,000	"	100	"	"	1,000 to	7,000 "	150 00
153—0 to	8,000	"	100	"	"	1,000 to	8,000 "	155 00
154—0 to	9,000	"	200	"	"	1,500 to	9 000 "	160 00
155—0 to	10,000	"	200	"	"	2,000 to	10,000 "	165 00

NOTE.—In ordering Instruments for Alternating Current Circuits, frequency or alternations per minute should be stated.

Discount, ...

TYPE "K,"
Switchboard Instruments.



The above line of Instruments is similar in all respects to our Type "K" Illuminated Dial line, except that the illuminating hood is omitted; the finish and construction is the same throughout. We can fully recommend them for use on switchboards where there is sufficient general illumination to obviate the necessity of illuminating the dial of each Instrument separately. Switchboard connections, finish and adaptability for use of both direct and alternating current are the same as in our Type "K," Illuminated Dial.

TYPE "K,"

Calibrated for either Direct or Alternating Current.

VOLTMETERS.

NO.						WORKING RANGE			PRICE
210—0 to	10	Volts in	$\frac{1}{10}$	Volt	divisions,	1 to	10	Volts,	$50 00
211—0 to	25	" "	$\frac{1}{2}$	"	"	5 to	25	"	51 00
212—0 to	40	" "	$\frac{1}{2}$	"	"	5 to	40	"	52 00
213—0 to	80	" "	1	"	"	10 to	80	"	53 00
214—0 to	130	" "	2	"	"	20 to	130	"	54 00
215—0 to	150	" "	2	"	"	20 to	150	"	55 00
216—0 to	300	" "	5	"	"	50 to	300	"	60 00
217—0 to	600	" "	10	"	"	100 to	600	"	65 00

AMMETERS.

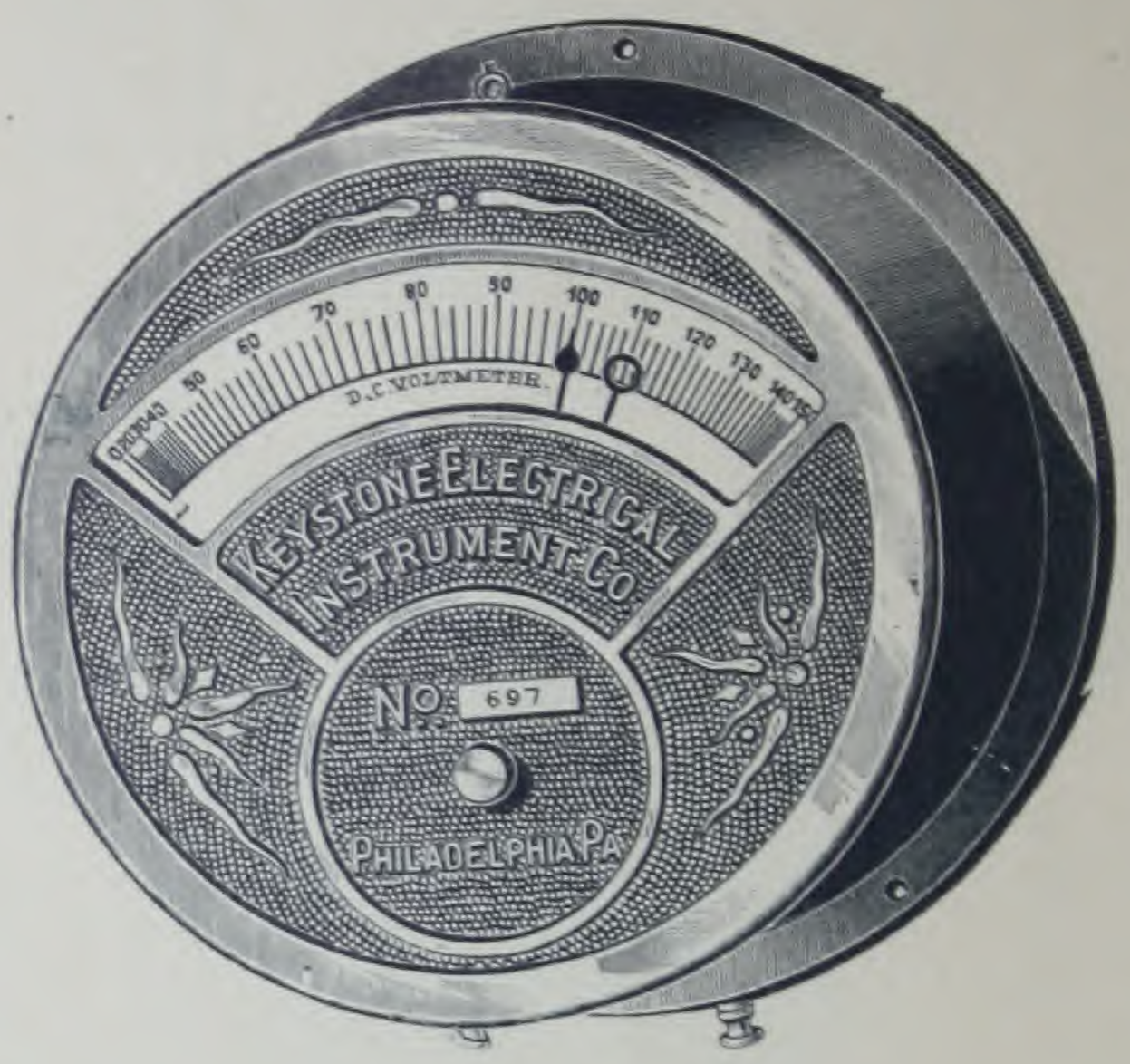
NO.						WORKING RANGE			PRICE
225—0 to	5	Amperes in	$\frac{1}{10}$	Amp.	divisions,	1 to	5	Amps.,	$42 00
226—0 to	10	" "	$\frac{1}{10}$	"	"	2 to	10	"	42 00
227—0 to	15	" "	$\frac{1}{5}$	"	"	3 to	15	"	42 00
228—0 to	25	" "	$\frac{1}{2}$	"	"	5 to	25	"	42 00
229—0 to	50	" "	$\frac{1}{2}$	"	"	10 to	50	"	42 50
230—0 to	75	" "	1	"	"	10 to	75	"	45 00
231—0 to	100	" "	1	"	"	20 to	100	"	46 25
232—0 to	125	" "	2	"	"	20 to	125	"	47 50
233—0 to	150	" "	2	"	"	20 to	150	"	48 75
234—0 to	175	" "	2	"	"	30 to	175	"	50 00
235—0 to	200	" "	2	"	"	30 to	200	"	51 00
236—0 to	250	" "	5	"	"	30 to	250	"	53 00
237—0 to	300	" "	5	"	"	50 to	300	"	55 00
238—0 to	400	" "	5	"	"	50 to	400	"	60 00
239—0 to	500	" "	10	"	"	50 to	500	"	65 00
240—0 to	600	" "	10	"	"	50 to	600	"	70 00
241—0 to	800	" "	10	"	"	100 to	800	"	75 00
242—0 to	1,000	" "	10	"	"	200 to	1,000	"	80 00
243—0 to	1,500	" "	20	"	"	300 to	1,500	"	85 00
244—0 to	2,000	" "	20	"	"	300 to	2,000	"	90 00
245—0 to	2,500	" "	25	"	"	300 to	2,500	"	95 00
246—0 to	3,000	" "	50	"	"	500 to	3,000	"	100 00
247—0 to	3,500	" "	50	"	"	500 to	3,500	"	105 00
248—0 to	4,000	" "	100	"	"	500 to	4,000	"	110 00
249—0 to	4,500	" "	100	"	"	500 to	4,500	"	115 00
250—0 to	5,000	" "	100	"	"	1,000 to	5,000	"	120 00
251—0 to	6,000	" "	100	"	"	1,000 to	6,000	"	125 00
252—0 to	7,000	" "	100	"	"	1,000 to	7,000	"	130 00
253—0 to	8,000	" "	100	"	"	1,000 to	8,000	"	135 00
254—0 to	9,000	" "	200	"	"	1,500 to	9,000	"	140 00
255—0 to	10,000	" "	200	"	"	2,000 to	10,000	"	145 00

NOTE.—In ordering Instruments for alternating Current Circuits, frequency or alternations per minute should be stated.

Discount, ...

TYPE "R,"

Switchboard Instruments.



These Instruments contain the same system as our Type "K," Illuminated Dial and Type "K" Instruments, and differ only in length of scale and style of case. They are neatly finished throughout, the body of the case being black japan and the front nickel plated. We can fully recommend them for installations in which this style of case would harmonize with the switchboard fittings, and can especially recommend them for feeder circuits in electric lighting or street railway installations. They are calibrated for use on either the direct current or the alternating of any frequency, and can be adapted for use on both direct and alternating current by the insertion of our inductive shunt at an advance of 10% on list price.

Prices on Ammeters above 2000 amperes will be given on application.

Cases will be finished in full nickel, brass or copper at an advance of $2.00 on list prices.

TYPE "R,"

Calibrated for either Direct or Alternating Current.

VOLTMETERS.

NO.		WORKING RANGE	PRICE
410	0 to 10 Volts in $\frac{1}{10}$ Volt divisions,	1 to 10 Volts,	$26 50
411	0 to 25 " " $\frac{1}{2}$ " "	5 to 25 "	27 00
412	0 to 40 " " $\frac{1}{2}$ " "	5 to 40 "	27 50
413	0 to 80 " " 1 " "	10 to 80 "	28 00
414	0 to 130 " " 2 " "	20 to 130 "	29 00
415	0 to 150 " " 2 " "	20 to 150 "	30 00
416	0 to 300 " " 5 " "	50 to 300 "	35 00
417	0 to 600 " " 10 " "	100 to 600 "	40 00

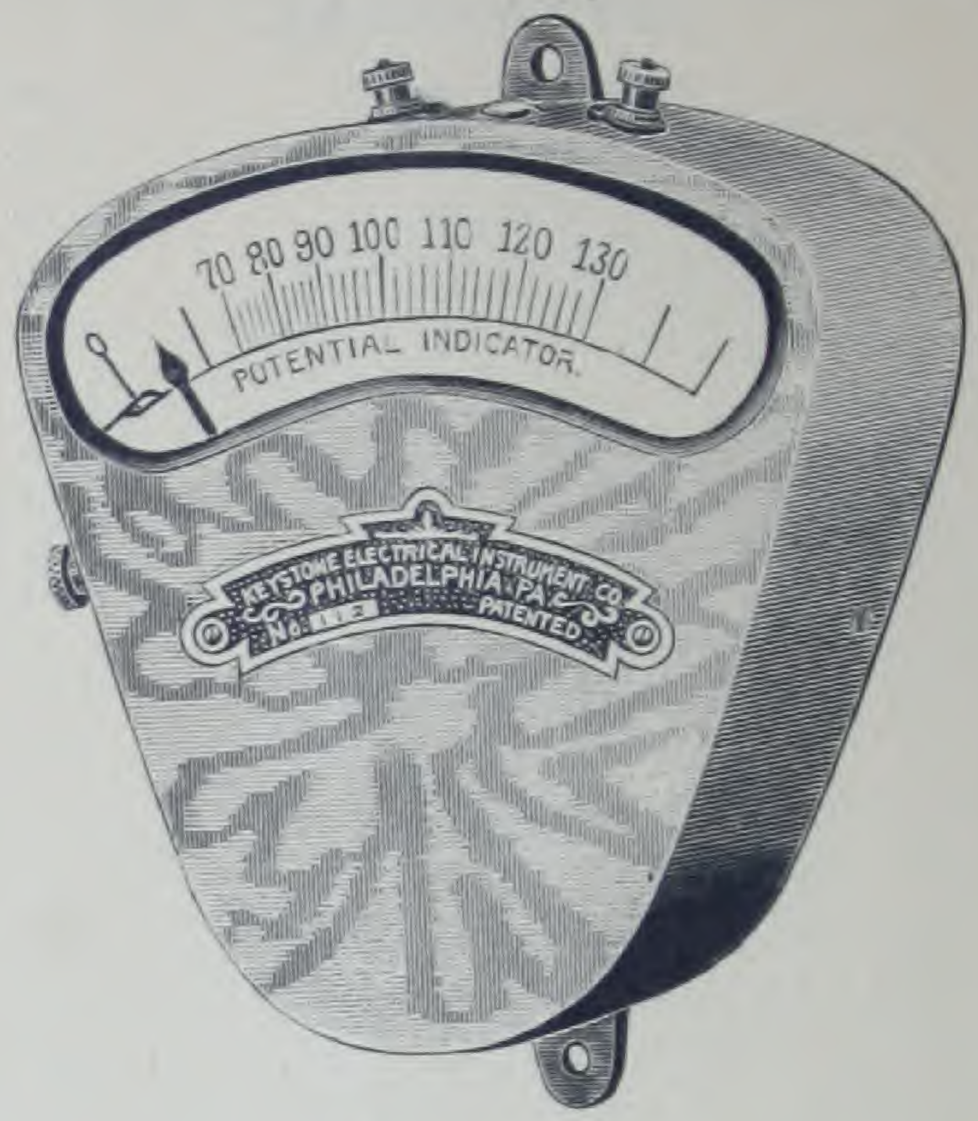
AMMETERS.

NO.		WORKING RANGE	PRICE
425	0 to 5 Amperes in $\frac{1}{10}$ Amp. divisions,	1 to 5 Amps.,	$25 00
426	0 to 10 " " $\frac{1}{10}$ " "	2 to 10 "	25 00
427	0 to 15 " " $\frac{1}{5}$ " "	3 to 15 "	25 00
428	0 to 25 " " $\frac{1}{2}$ " "	5 to 25 "	25 00
429	0 to 50 " " $\frac{1}{2}$ " "	10 to 50 "	25 50
430	0 to 75 " " 1 " "	10 to 75 "	26 00
431	0 to 100 " " 1 " "	20 to 100 "	26 50
432	0 to 125 " " 2 " "	20 to 125 "	27 00
433	0 to 150 " " 2 " "	20 to 150 "	27 50
434	0 to 175 " " 2 " "	30 to 175 "	28 00
435	0 to 200 " " 2 " "	30 to 200 "	28 50
436	0 to 250 " " 5 " "	30 to 250 "	29 00
437	0 to 300 " " 5 " "	50 to 300 "	29 50
438	0 to 400 " " 5 " "	50 to 400 "	30 00
439	0 to 500 " " 10 " "	50 to 500 "	30 50
440	0 to 600 " " 10 " "	100 to 600 "	31 00
441	0 to 700 " " 10 " "	100 to 700 "	31 50
442	0 to 800 " " 10 " "	100 to 800 "	32 00
443	0 to 900 " " 10 " "	200 to 900 "	32 50
444	0 to 1,000 " " 10 " "	200 to 1,000 "	33 00
445	0 to 1,250 " " 20 " "	300 to 1,250 "	36 00
446	0 to 1,500 " " 20 " "	300 to 1,500 "	40 00
447	0 to 2,000 " " 20 " "	400 to 2,000 "	43 00

NOTE.—In ordering Instruments for Alternating Current Circuits, frequency or alternations per minute should be stated.

Discount,.....

Switchboard Potential and Current Indicators.



In presenting the line of Switchboard Potential and Current Indicators illustrated by the above cut we believe we have successfully solved the problem involved in the production of a thoroughly reliable and accurate Indicator at a very low price.

These Instruments are mounted in a tastefully designed case, finished in oxidized copper and well lacquered. They are well made, strong and substantial, moving parts mounted in jewelled bearings, cases dust proof, and are not affected by external magnetism or changes of temperature. They are accurately calibrated from absolute standards before leaving our laboratory, and will retain their accuracy indefinitely, since nothing subject to change or deterioration is incorporated.

While the price at which we are offering them is low, they are not cheap in construction or detail, but will be found accurate and durable. We can fully recommend them for use in isolated plants, or for use on feeder circuits in large installations.

Keystone Switchboard Potential and Current Indicators.

POTENTIAL INDICATORS.

NO.		PRICE
555.	Working scale from 20 to 70 Volts in 1 Volt divisions,	$20 00
556.	" " " 70 to 130 " " 2 " "	20 00
557.	" " " 160 to 260 " " 5 " "	23 00
558.	" " " 300 to 600 " " 10 " "	28 00

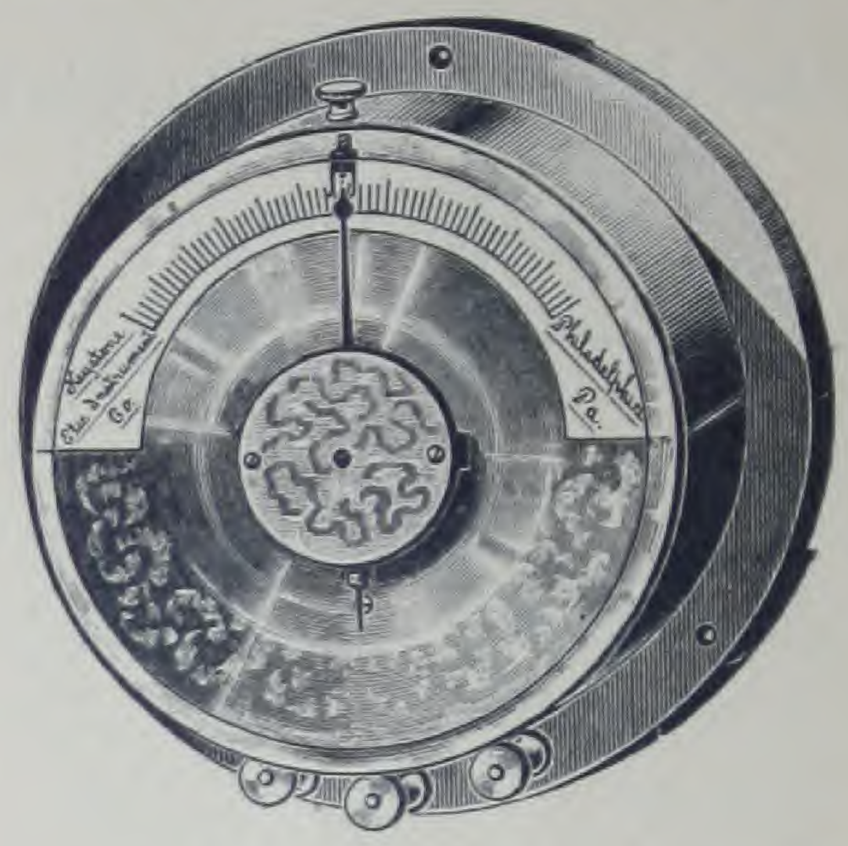
CURRENT INDICATORS.

NO.		PRICE
560.	Working Scale from 5 to 25 Amps. in ½ Amp. divisions,	$20 00
561.	" " " 10 to 50 " " 1 " "	20 00
562.	" " " 20 to 100 " " 2 " "	20 50
563.	" " " 30 to 150 " " 2 " "	21 00
564.	" " " 40 to 200 " " 5 " "	21 50
565.	" " " 50 to 250 " " 5 " "	22 00
566.	" " " 60 to 300 " " 5 " "	23 00
567.	" " " 80 to 400 " " 10 " "	25 00
568.	" " " 100 to 500 " " 10 " "	27 00

Discount,.....

NOTE.—In ordering Instruments for Alternating Current Circuits, frequency or alternations per minute should be stated.

Switchboard Galvanometer and Ground Detector for Constant Potential Circuits.



These Instruments are designed to indicate the presence of a ground on a line, and are made for use on both direct and alternating current circuits. For use on direct current circuits the Instruments are constructed as shown in the illustration, with a central zero and three binding-posts, the central binding-post to be connected to ground and the two outside ones to the positive and negative side of line. They are intended to be left in circuit continuously and the presence of a ground will be shown by the deflection of the pointer from its normal position at zero.

For use on alternating current, zero is at the left of scale and two binding-posts only are provided, one of which is to be connected to ground and the other to either side of the line by means of a Voltmeter switch.

In practice we recommend on the alternating current the Ground Detector be connected to the secondary of a special transformer, thus obviating the necessity of putting in the Instrument sufficient resistance to stand the high voltage on the primary side of the line.

We give below diagrammatic sketches showing method of connecting these Instruments to the bus-bars on the direct current two or three wire system, also method of connecting alternating current Instruments directly across the line or on the secondary of a transformer.

Figure 1 shows the connections for a two wire direct current system.

Figure 2 shows the connections for the three wire direct current system.

Figure 3 shows the Instrument connected to indicate the difference in potential between the two sides of a three wire system.

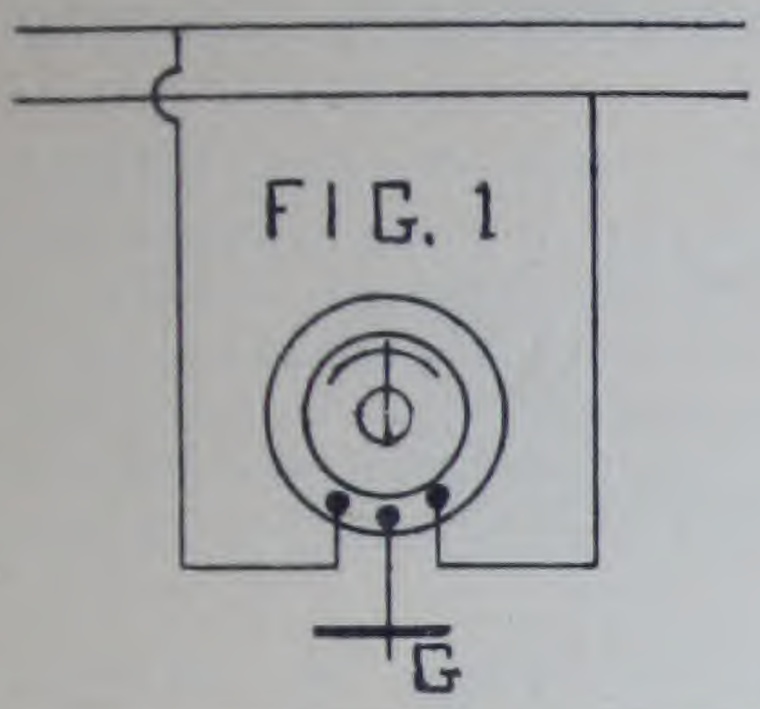
Figure 4 shows the connections across the mains of the alternating current.

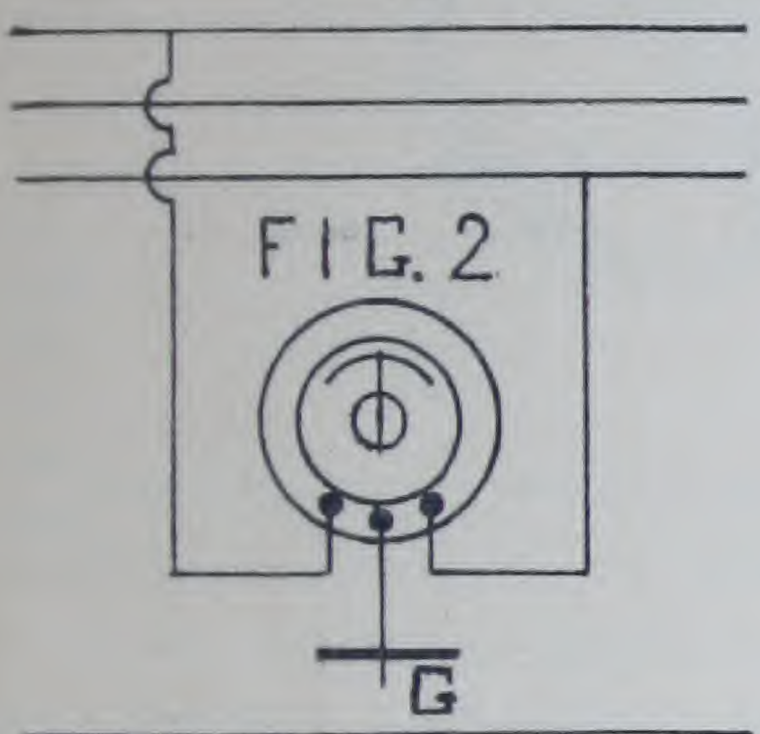
Figure 5 shows the connections when the Instrument is set in the secondary of a transformer.

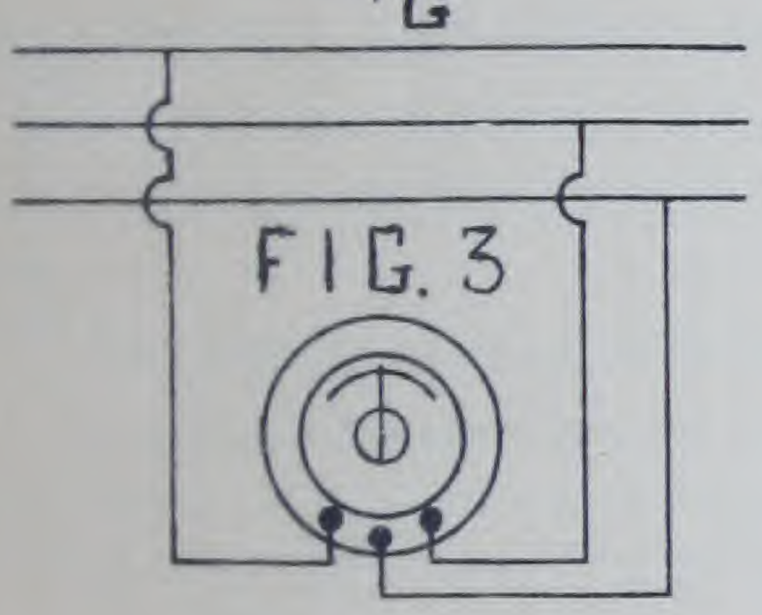
The scales of these Instruments are divided into degrees, and charts will be furnished giving the values of the divisions in volts or the values of the divisions in ohms for any given line potential.

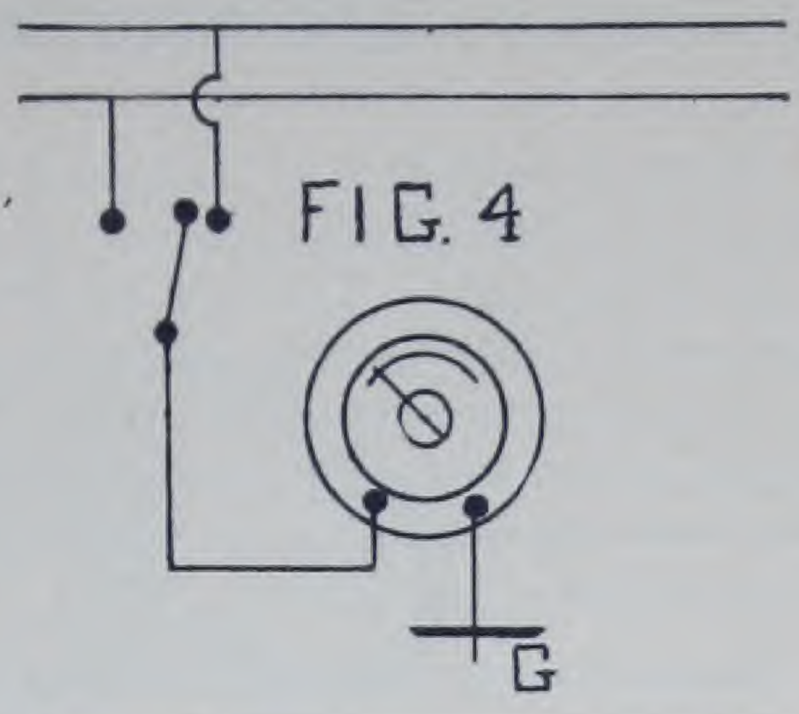
Standard finish: Brass case, grained and lacquered, with bevel glass front.

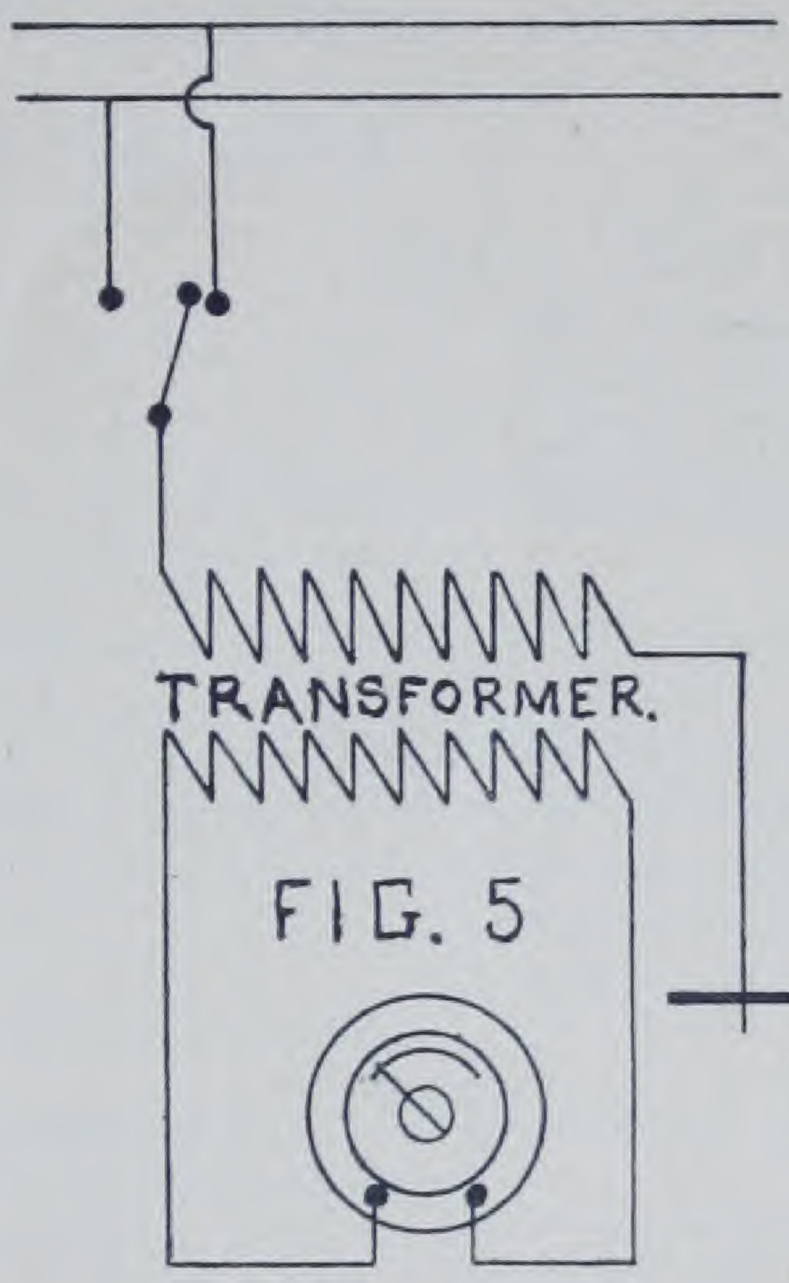
Cases finished in full nickel, on special order.











NO.		RANGE	PRICE
610—	For Alternating Current only	0 to 60 Volts,	$62 00
611—	" Direct " "	110—0—110 "	63 00
612—	" Alternating " "	0 to 120 "	64 00
613—	" Direct " "	125—0—125 "	65 00
614—	" " " "	300—0—300 "	67 00
615—	" " " "	600—0—600 "	70 00

Discount,

Prices on Ground Detectors to be used on primary side of alternating current circuits will be given on application.

Differential Voltmeters.

These Instruments are designed for use on direct current circuits to indicate the difference of potential between two or more dynamos when running in parallel on the same set of bus-bars. They are provided with four binding-posts, two of which are to be connected to the bus-bars, the other two to the terminals of any dynamo which is to be cut in on the same set of bus-bars. The voltage of the dynamo to be cut in acts in opposition to the voltage on the bus-bars, and when the two are equal the pointer will stand at zero, thus enabling the attendant to throw dynamos in parallel without danger to the machines or the system.

These Instruments are mounted in cases similar to our Type "K," Illuminated Dial, or our Type "K" Instruments.

TYPE "K," ILLUMINATED DIAL.

NO.	RANGE	PRICE
510—	80—0— 80 Volts,	$88 00
511—	130—0—130 "	89 00
512—	150—0—150 "	90 00
513—	300—0—300 "	95 00
514—	600—0—600 "	100 00

TYPE "K."

NO.	RANGE	PRICE
525—	80—0— 80 Volts,	$68 00
526—	130—0—130 "	69 00
527—	150—0—150 "	70 00
528—	300—0—300 "	75 00
529—	600—0—600 "	80 00

Discount, ...

Arc Ammeters.

We are prepared to furnish Ammeters for Arc Light service, mounted in either our Type "R," or Potential Indicator case.

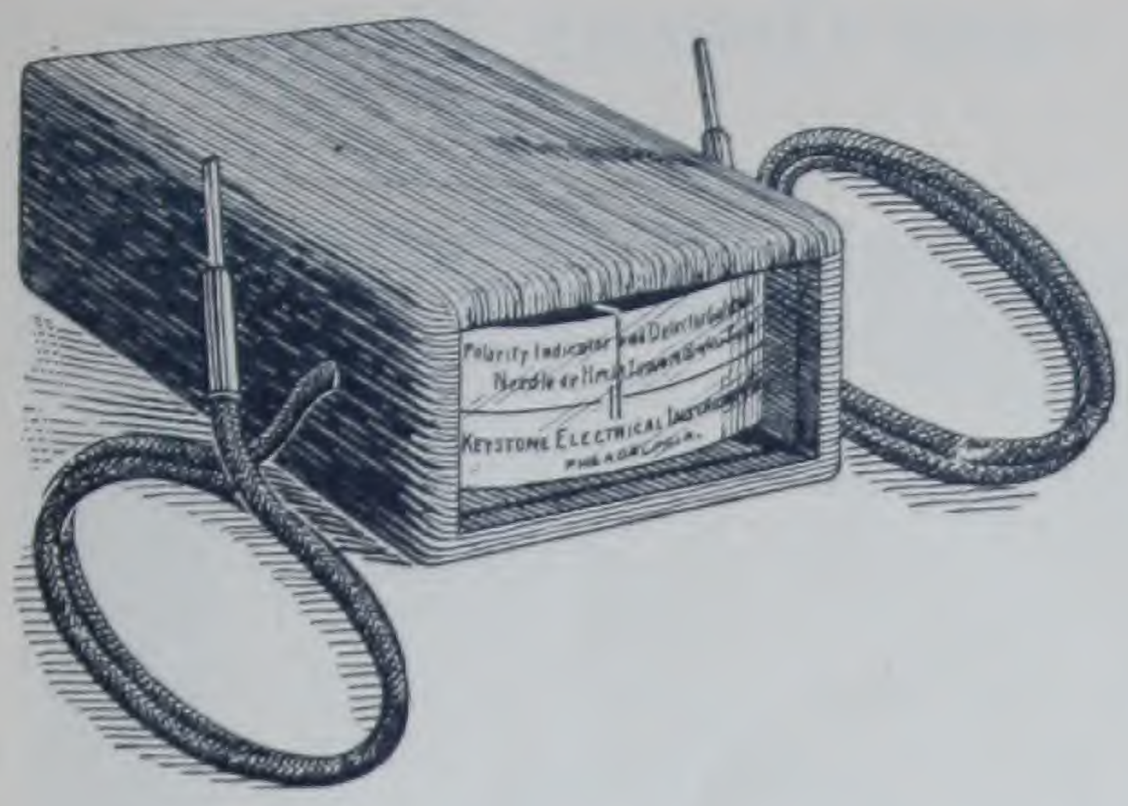
Each Instrument is provided with a direction indicator showing the direction of the current flow.

These Instruments are made with either front or back connections, and any particularly running point will be clearly marked on scale if so desired.

NO.	RANGE	PRICE
560—	10 Amperes,	$30 00

Discount, ...

Polarity Indicator and Detector Galvanometer.



This little Instrument is designed to indicate polarity of light and power mains on two and three wire circuits, also polarity of dynamos and batteries.

It will indicate on circuits from 1 volt to 700 volts and a short-circuit cannot be made through it. Will be found very useful in setting arc lamps or motors.

Mounted in a neat polished walnut case, small enough to be conveniently carried in the pocket; size, $3\frac{1}{2} \times 2\frac{1}{2} \times 1\frac{3}{8}$ inches; weight, $4\frac{1}{2}$ ounces and is fitted with terminal leads.

The pointer always deflects toward positive terminal.

It will further be found very useful as a pocket detector galvanometer and is applicable to all uses for which detector galvanometers are adapted.

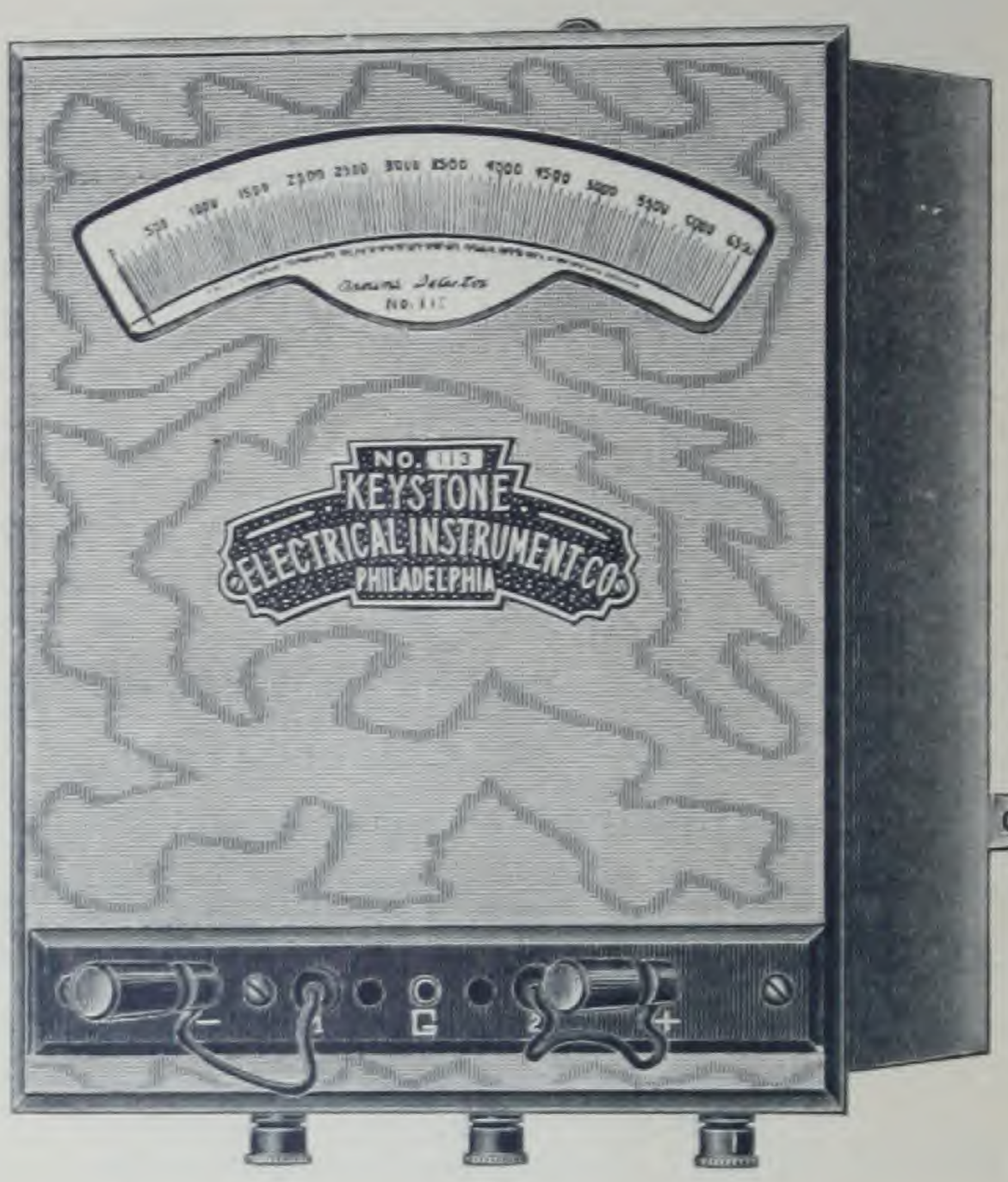
Workmanship and material are the best throughout and with careful treatment the Instrument should last a lifetime.

We can particularly recommend this Instrument for use in testing circuits in lighting and power stations. It will be found particularly useful in showing whether circuits are "alive" or "dead," locating grounds and in general for all rough galvanometric measurements, having the advantage that it can be used on high potential circuits without danger of damage. For battery use we recommend our lower range Instrument, which will give larger deflections on very low voltage.

NO.	RANGE	PRICE
552—0 to	20 Volts,	$3 00
553—0 to	700 "	3 00

Discount,

The Keystone Arc Light Voltmeter and Ground Detector.



The Keystone Arc Light Voltmeter and Ground Detector combines in one Instrument:

A Voltmeter which will indicate the actual voltage of each circuit, or the total voltage of the generator, and consequently the number of lamps burning, and a Ground Detector which will indicate a ground, determine its character and location.

It will indicate the character of the ground, its resistance, and its location on the lines by taking three readings and equating them in simple formulæ.

It can be used when the circuit is "alive" thus giving results under working conditions.

It replaces a cable testing set which has proved extremely unsatisfactory owing to the many microphone contacts in circuit.

It is self-contained, well made, accurate, reliable, dead-beat, unaffected by external fields or changes in temperature, easy and safe to manipulate, and low in price.

In connection with a set of switches and a battery of cells, or an ordinary incandescent circuit, it can be used to test the continuity of the line and the resistance from line to earth during the day and for this purpose will be found much easier to handle, more accurate in results and quicker in action than any galvanometer and bridge method.

To take up these points more in detail, we believe Central Station Managers are commencing to realize the importance of the voltmeter in series arc stations. It has long been the practice in even the very small isolated plants employing the constant potential system, to install both a voltmeter and an ammeter; while as yet but few series arc systems are equipped with more than an ammeter, which for this system performs practically the same functions as the voltmeter in the constant potential. It is, however, just as essential that the Station Manager or Switchboard Attendant should be able to read the passing load on the series arc system as on the constant potential, and this passing load can only be read by means of a voltmeter properly designed for that class of service. Many stations have attempted to employ a voltmeter calibrated to either 150 or 600 volts in connection with a multiplier, but such a device is far inferior to a voltmeter calibrated directly for the voltage employed. The Keystone Arc Light Voltmeter and Ground Detector has the advantage of being direct reading and has no detachable multiplier box taking up valuable space back of the switchboard and liable to be left out of circuit when high voltage readings are taken. Furthermore the Instrument we offer is constructed throughout to withstand the high voltage of the arc light circuit without possible burning out or damage from defective insulation or poor connections. When combined with such a voltmeter we are able to offer an Instrument possessing the advantages of a ground detector by means of which a Switchboard Attendant can note the presence of a ground, and can also determine its character and actually locate it on the line, we believe we are offering an instrument which will meet with the unqualified approval of Central Station Managers.

An idea of the general appearance of the Instrument may be obtained from the cut, and, in further explanation, we would say that it consists of a compound galvanometer system, mounted in a case which effectually shields the instrument from the influence of external fields. This case is finished in oxidized copper, well lacquered, and presents an attractive appearance. The scale is practically uniform from zero to maximum reading, indications are dead-beat, and the temperature co-efficient of the wire employed is so small that external changes of temperature makes no difference in indications.

In setting up the Instrument all that is necessary is to secure it to the switchboard by means of the lugs provided, taking care that the pointer stands at zero when no current is passing through the Instrument.

The blue printed sheet of Instructions accompanying each Instrument gives directions which we believe are simple and explicit enough to enable any Switchboard Attendant to set the Instrument up and operate it successfully.

In ordinary practice it will be found convenient to connect the central binding post to any ground connection available, as for instance the earth side of the lightning arresters, while the + and — posts may be connected to the spare cups on the board, there being nearly always available one such pair of cups provided for testing purposes.

Then by plugging from these two cups into the terminals of any circuit on the board the voltage of this circuit may be read and by dividing by the drop per lamp the number of lamps burning on the circuit may be ascertained. Then leaving the switchboard plugs in place, instrument plug 1 having been in receptacle marked — and instrument plug 2 in receptacle marked + leave instrument plug 2 in receptacle marked + and place instrument plug 1 in receptacle marked G, this will give the voltage of the ground on the + side of line. Then place instrument plug 1 in receptacle marked — and instrument plug 2 in receptacle marked G, this will give the voltage of the ground on the — side of the line.

Having obtained the three readings noted above insert their values in the equation

$$N = \frac{A\ C}{D\ (A+B)}$$

In this equation N= the number of the lamps, counting out from the + terminal of the dynamo just beyond which the ground is located.

C= potential of dynamo or the difference of potential at the terminals of the circuit under test.

A= potential of ground on + side of line.

B= potential of ground on — side of line.

D= drop in volts for one lamp.

For example :—Let A=100 volts, B=400 volts, C=1000 volts, D=50 volts.

Applying the above formula, $N = \frac{100 \times 1000}{50\ (100+400)} = \frac{100{,}000}{25{,}000}$ or 4.

This means that the ground is just beyond the fourth lamp (Counting out from the + terminal of the dynamo).

If the sum A+B=C there is a dead ground, if the sum is less than C the ground is partial.

This is evident from the fact that when the instrument is directly across the terminals of the circuit it indicates the voltage of the circuit in the same manner as any ordinary voltmeter; but, when connected from either + or — side of line to ground it reads the potential difference between that side of the line and the earth. If the ground is "dead" no resistance is in the series with the instrument and the sum of the two ground readings must equal the total potential of the circuit, the voltage readings indicating the drop from the dynamo terminals to the grounded point. If, however, the ground is only partial then the resistance of the ground is in series with the resistance of the Instrument and acts as a multiplier, the multiplying factor being expressed by the term $\frac{C}{A+B}$ and the employment of this factor in the equation gives the ground location when it is partial.

To find the resistance of the ground using the readings above:
Call R′ the resistance of the ground and R the resistance of the Instrument;

$$\text{Then } R' = \frac{(C-A-B)}{(A+B)} \; R$$

To use this instrument for the purpose of testing lines during the daytime we recommend a set of switches by means of which the connections shown in the cuts below can be readily made. These switches can readily be mounted on a portable switchboard if desired.

The first figure shows connections as they should be prior to closing any of the switches or starting test.

The second figure shows the position of the switches so that the voltage of the incandescent dynamo or set of batteries, whichever may be employed for the purpose, may be read.

Figure 3 shows the position of the switches for the test for continuity of circuit, and the reading of the voltmeter should be practically the same as with connections shown in Figure 2.

Figures 4 and 5 show the positions of the switches in order to obtain the resistance between the line and earth on the + and − side of the line respectively.

Now the deflection of the instrument is inversely proportional to the resistance in circuit and so is the measure of the insulation resistance. Therefore, having obtained the first, the E. M. F. on the generator, or the batteries, which we will call E, and knowing the resistance of the instrument, which we will call R; then denoting by V the voltage as shown by the instrument when the connection is made to ground on either + or − side, and by R′, the resistance between line and earth, we have the equation

$$R' = \frac{E\ R}{V} - R$$

In practice it is not necessary to calculate the resistance for each observation, provided E can be kept constant, for a table can be readily made giving the value of the insulation resistance for any given deflection shown on the instrument. In practice it is well to employ a fairly high voltage for these tests, particularly in testing continuity of circuit, otherwise the line is liable to show open from the fact that the resistance between the carbon points and in the lamp mechanism may be sufficiently great to show open circuit on low voltage.

As a precautionary measure we do not advise that the instrument be left in circuit continuously across the terminals of the dynamo. It should be left idle except during such time as is actually employed in testing.

We do not claim to be able to locate every leak on a line when the general insulation of a line is poor. Such cases frequently arise on rainy days when the cables are liable to have a small leak along their whole length, whether these cables be underground or overhead.

We do claim, however, that the presence of the ground will be indicated, and if the ground at any one point is serious its location can be exactly calculated.

Practical experience with arc light lines and the use of such an instrument will, in a short time, teach the Switchboard Attendant just what deflections are dangerous and just what are allowable. We claim, and we are prepared to substantiate our claim, that by the use of this instrument more testing can be actually accomplished from the switchboard and more definite results obtained than with any other form of testing device heretofore offered. The expense of patrolling the lines every day, looking for possible trouble is entirely obviated. All that is necessary is that the Night Attendant should keep a log of any bad grounds he may discover during the night's run, and this report having been turned over to the "Trouble Man" in the morning, prompt repairs of defective insulation may be made.

Price List of Keystone Arc Light Voltmeter and Ground Detector.

No. 630	Range 0 to 1,500 volts,	Capacity	25 lights,	. . . . .	Price	$130.00
" 631	" 0 " 3,000 "	"	50 "	. . . . .	"	150.00
" 632	" 0 " 5,500 "	"	100 "	. . . . .	"	170.00
" 633	" 0 " 6,500 "	"	125 "	. . . . .	"	180.00

Scale divisions 50 volts each

Prices on higher ranges on application.

Connections for Keystone Arc Light Voltmeters and Ground Detectors

When Used to Test Insulation Resistance of Lines.

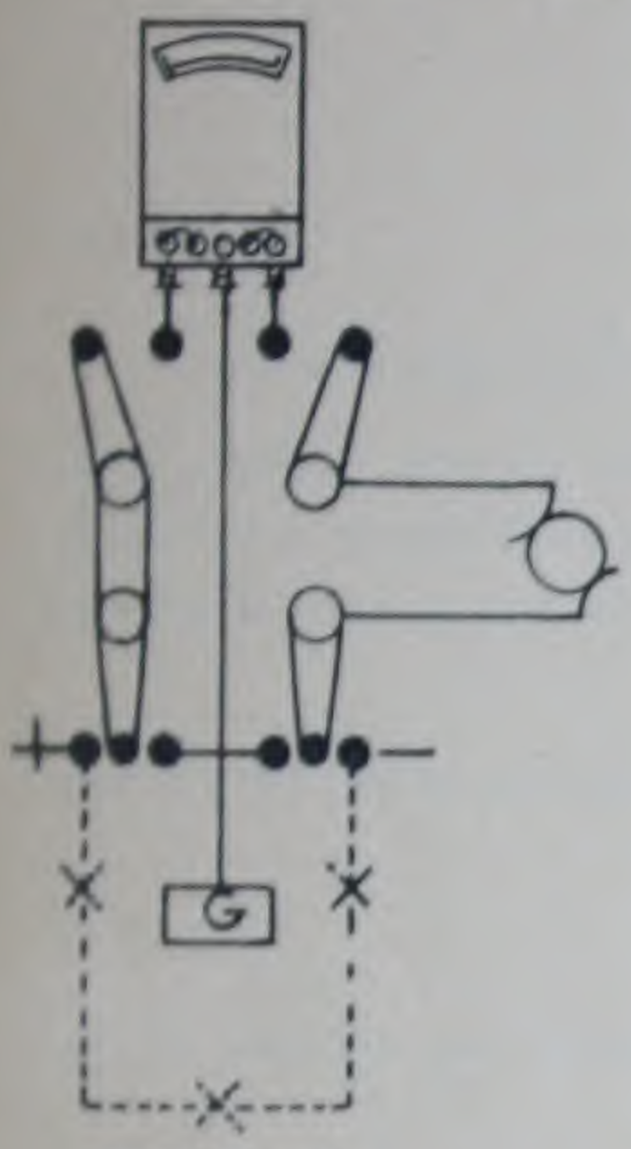


FIG. 1.

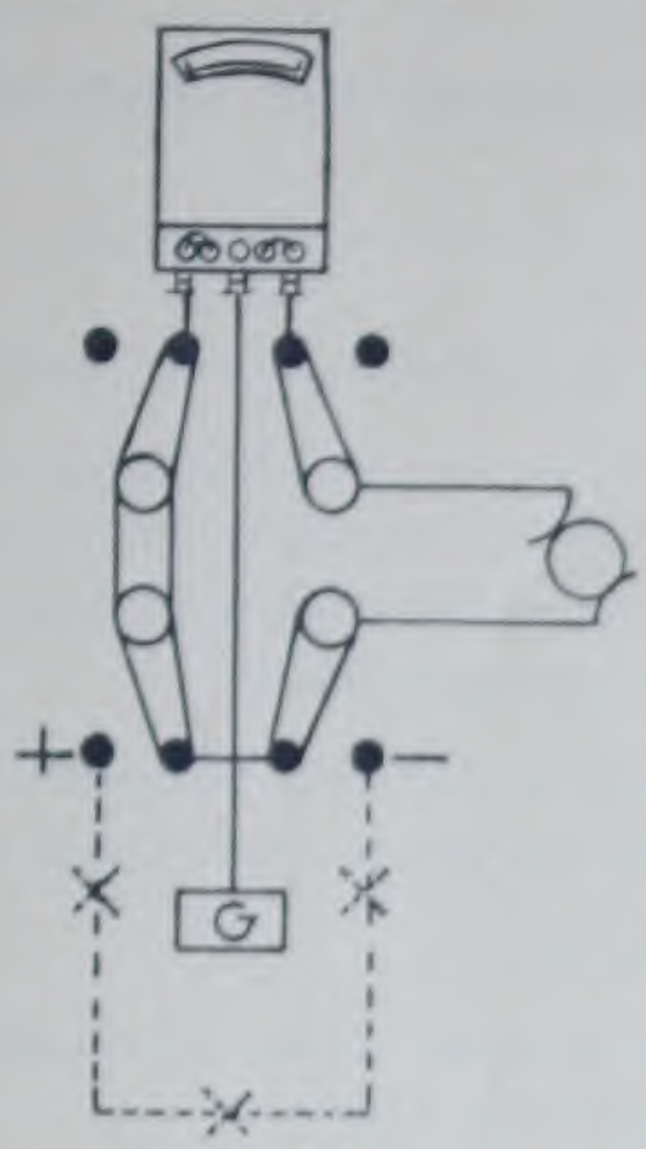


FIG. 2.

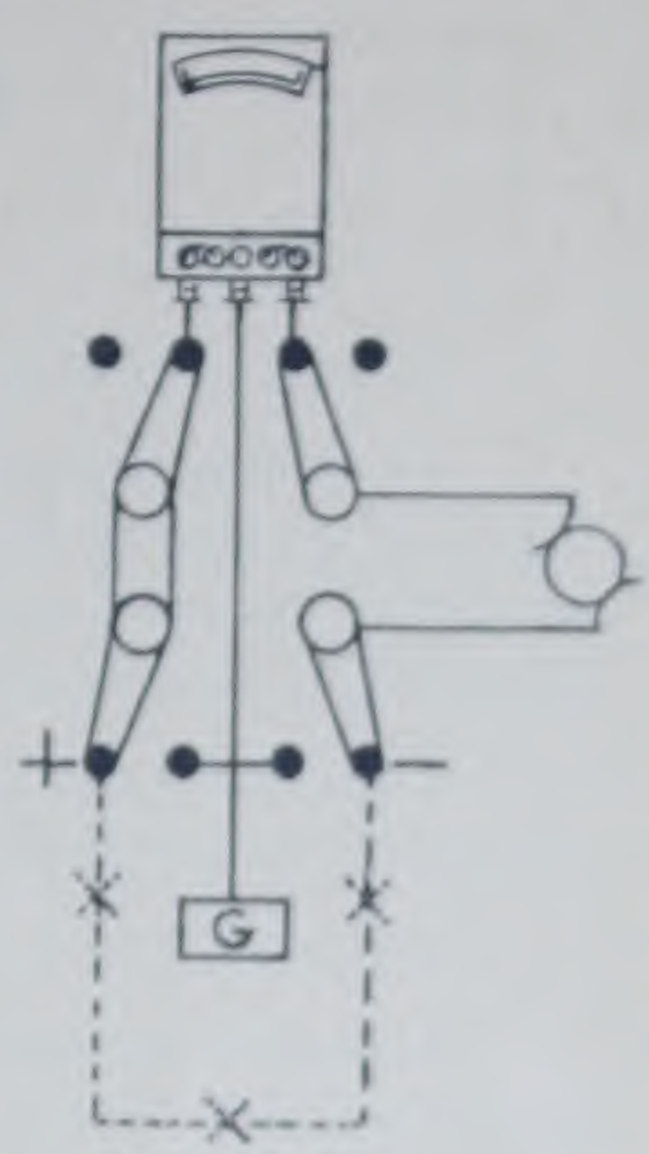


FIG. 3.

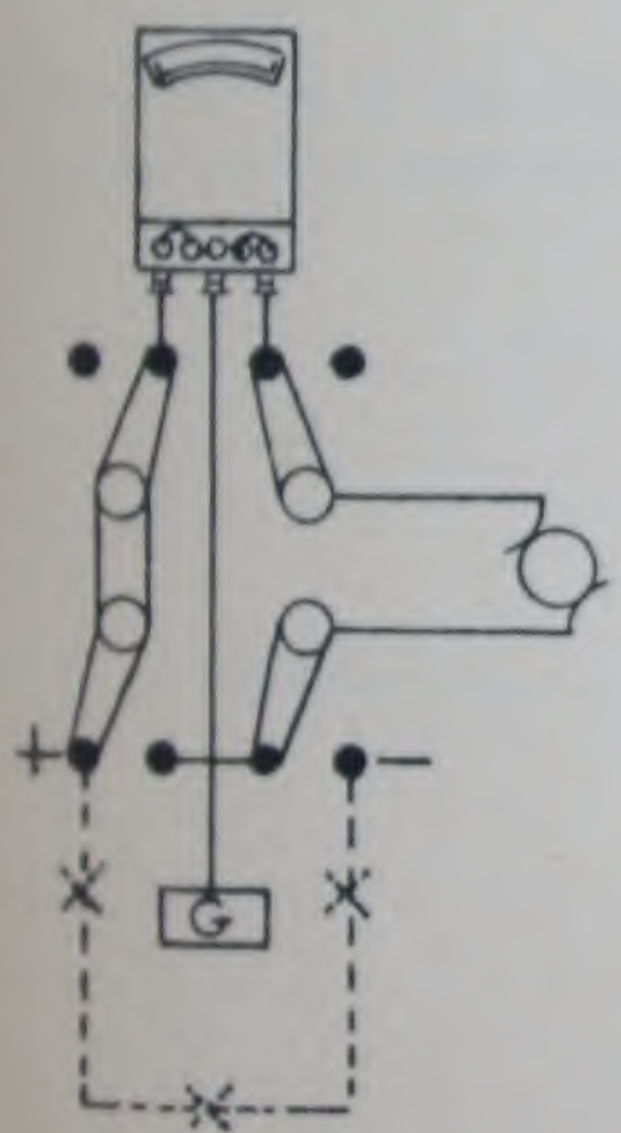


FIG. 4

FORMULA

$$R' = \frac{E\ R}{V} - R$$

R′= Insulation resistance from line to earth.

E= Voltage of test circuit as read on Instrument.

R= Resistance of Instrument.

V= Reading of Instrument in volts.

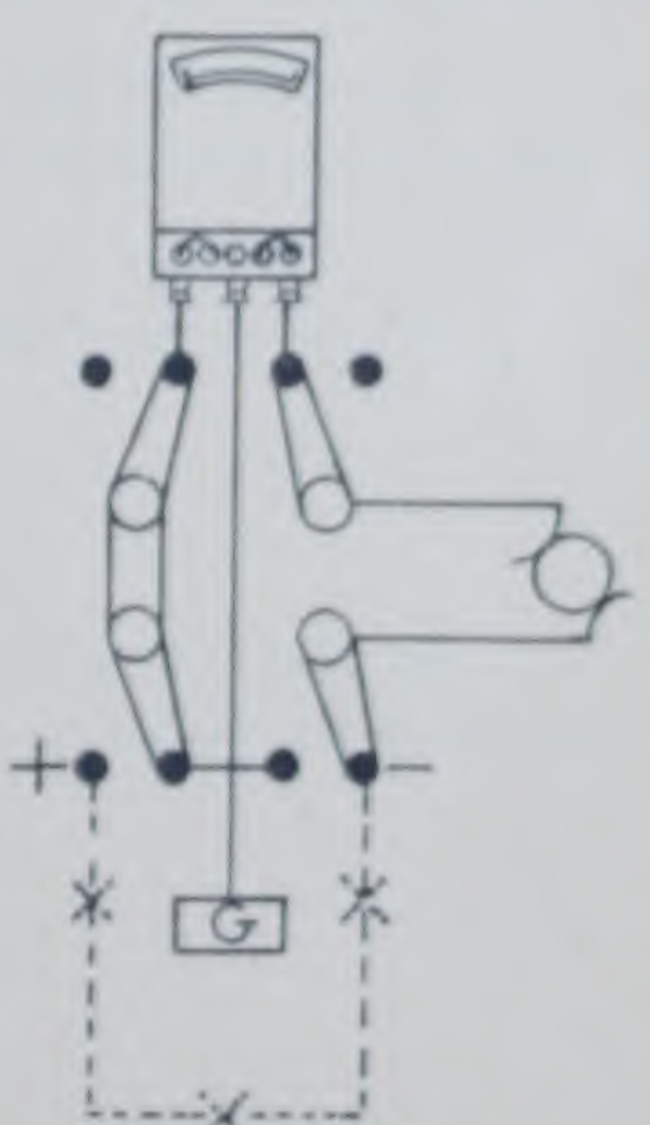


FIG. 5.

Directions for Ordering.

In order to avoid mistakes in shipment, kindly order by Catalogue number.

In ordering Instruments for use on alternating current circuits where a high degree of accuracy is desired, always specify the frequency or alternations per minute employed. If any of our Switchboard Instruments are desired for use on both direct and alternating current circuits, specify same clearly.

Unless otherwise directed, we will ship Standard Instruments as per list; if any variation in scale or finish is desired, specify same clearly.

All prices f. o. b. Philadelphia.

Shipments are made by express, unless otherwise ordered, on account of the greater care given during shipment by carriers.

All Instruments are sealed before shipment, and we accept no responsibility for Instruments in which the seals have been broken.

Our terms are cash 30 days from invoice, and parties unknown to us will save time and inconvenience by forwarding draft with order, or furnishing us with references.

All prices are based on standard finish, as given under cuts.

CAUTION.

See that every Instrument is sealed when received and accompanied by a certificate bearing the serial number of the Instrument.

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